Attorney's Docket No. 1030681-000578

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of Young-dong Lee et al. Application No.: 10/684,522 Filed: October 15, 2003 For: INDUCTIVELY COUPLED PLASMA GENERATING APPARATUS INCORPORATING SERPENTINE COIL ANTENNA	Group Art Unit: 1763 Examiner: LUZ L ALEJANDRO MULERO Appeal No.: _____

APPEAL BRIEF

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Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

This appeal is from the decision of the Primary Examiner dated June 28, 2007 finally rejecting claims 1-30, which are reproduced as the Claims Appendix of this brief.

☐ A check covering the ☐ $ 255 ☐ $ 510 Government fee is filed herewith.

☒ Charge ☐ $ 255 ☒ $ 510 to Credit Card. Form PTO-2038 is attached.

The Commissioner is hereby authorized to charge any appropriate fees under 37 C.F.R. §§1.16, 1.17, and 1.21 that may be required by this paper, and to credit any overpayment, to Deposit Account No. 02-4800.

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I. Real Party in Interest

The present application is assigned to Samsung Electronic Co., Ltd. Samsung Electronic Co., Ltd. is the real party in interest, and is the assignee of Application No. 10/684,522.

II. Related Appeals and Interferences

The Appellants' legal representative, or assignee, does not know of any other appeal or interferences which will affect or be directly affected by or have bearing on the Board's decision in the pending appeal.

III. Status of Claims

Claims 1-3, 9-21, and 25-32 are pending and all are presently rejected. Claims 1-3, 9-21, and 25-32 are the subject of the present appeal and are set forth in Appendix A.

IV. Status of Amendments

An Amendment is filed herewith and concurrently with this Appeal Brief to correct an informality in Claim 31. This Amendment has not been entered, but all other amendments have been entered by the Examiner. Claim 31 is listed without the concurrently filed amendment.

V. Summary Claimed Subject Matter

A. Claim 1 and Claims Dependent from Claim 1

Claim 1 is directed to an inductively coupled plasma (ICP) generating apparatus as illustrated in Figures 6 and 11 and discussed on page 6, lines 14-33, page 9, line 33 to page 12, line 10 and page 14, line 21 to page 15, line 22, for example, and recites:

An inductively coupled plasma (ICP) generating apparatus comprising:

an evacuated reaction chamber (110);

an antenna (120/320) installed at an upper portion of the reaction chamber (110) to induce an electric field for ionizing reaction gas supplied into the reaction chamber (110) and generating plasma; and

a radio frequency (RF) power source (132) connected to the antenna (120/320) to apply radio frequency power to the antenna (120/320),

wherein the antenna (120/320) comprises a plurality of coils comprising an open ended first continuous serpentine coil (324), an open ended second continuous circular coil (322), and an open ended third continuous serpentine coil (326) surrounding the first continuous serpentine coil (324), wherein the first (324) and third (326) serpentine coils are bent in a zigzag pattern, and wherein the first (324) and third (326) serpentine coils comprise an outer loop, an inner loop, and connecting portions between the outer loop and the inner loop, wherein the outer loop of the first serpentine coil (324) and the outer loop of the third serpentine coil (326) are approximately parallel, the inner loop of the first serpentine coil (324) and the inner loop of the third serpentine coils (326) are approximately parallel, the connecting portions of the first serpentine coil (324) are approximately parallel to the connecting portions of the third serpentine coil (326) and are longer than the connecting portions of the third serpentine coil (326), and the first serpentine coil (324) does not overlap or cross the any portion of the third serpentine coil (326).

Claim 2 is directed to an inductively coupled plasma (ICP) generating apparatus as illustrated in Figures 6 and 11 and discussed on page 6, lines 14-33, page 9, line 33 to page 12, line 10 and page 14, line 21 to page 15, line 22, for example, and recites the inductively coupled plasma generating apparatus of claim 1, wherein the circular coil (322) is arranged at a center portion of the antenna (120/320) and the first serpentine coil is arranged around and connected to the circular coil (322), and wherein the third serpentine coil (326) is shaped to nest around and outline the first serpentine coil (324).

Claim 3 is directed to an inductively coupled plasma (ICP) generating apparatus as illustrated in Figures 6 and 11 and discussed on page 6, lines 14-33, page 9, line 33 to page 12, line 10 and page 14, line 21 to page 15, line 22, for example, and recites the inductively coupled plasma generating apparatus of claim

2, wherein the circular coil (322) has a relatively small radius to reduce the area of opposing portions between the circular coil (322) and the serpentine coil.

Claim 9 is directed to an inductively coupled plasma (ICP) generating apparatus as illustrated in Figures 6 and 11 and discussed on page 6, lines 14-33, page 9, line 33 to page 12, line 10 and page 14, line 21 to page 15, line 22, for example, and recites the inductively coupled plasma generating apparatus of claim 1, wherein the first (324) and third (326) serpentine coils have a zigzag pattern with equally spaced outer loop and inner loop sections, and wherein the first (324) and third (326) serpentine coils have an equal number of equally spaced outer loop and inner loop sections.

Claim 10 is directed to an inductively coupled plasma (ICP) generating apparatus as illustrated in Figures 6 and 11 and discussed on page 6, lines 14-33, page 9, line 33 to page 12, line 10 and page 14, line 21 to page 15, line 22, for example, and recites the inductively coupled plasma generating apparatus of claim 9, wherein the first (324) and third (326) serpentine coils have a plurality of outer portions extending along the circumference and a plurality of inner portions bent toward the center portion.

Claim 11 is directed to an inductively coupled plasma (ICP) generating apparatus as illustrated in Figures 6 and 11 and discussed on page 6, lines 14-33, page 9, line 33 to page 12, line 10 and page 14, line 21 to page 15, line 22, for example, and recites the inductively coupled plasma generating apparatus of claim 10, wherein the inner and outer loops of the first (324) and third (326) serpentine coils are arranged to correspond to center and edge portions of the reaction chamber (110), respectively.

Claim 12 is directed to an inductively coupled plasma (ICP) generating apparatus as illustrated in Figures 6 and 11 and discussed on page 6, lines 14-33, page 9, line 33 to page 12, line 10 and page 14, line 21 to page 15, line 22, for example, and recites the inductively coupled plasma generating apparatus of claim 1, wherein the plurality of coils further comprise at least one connection coil (128/328), wherein the connection coil (328a) connects the first serpentine coil (324) and the circular coil (322) of the plurality of coils.

Claim 13 is directed to an inductively coupled plasma (ICP) generating apparatus as illustrated in Figures 6 and 11 and discussed on page 6, lines 14-33, page 9, line 33 to page 12, line 10 and page 14, line 21 to page 15, line 22, for example, and recites the inductively coupled plasma generating apparatus of claim 1, wherein the first serpentine coil (324)'s zigzag pattern has a rectangular cross-section having a width smaller than height.

Claim 14 is directed to an inductively coupled plasma (ICP) generating apparatus as illustrated in Figures 6 and 11 and discussed on page 6, lines 14-33, page 9, line 33 to page 12, line 10 and page 14, line 21 to page 15, line 22, for example, and recites the inductively coupled plasma generating apparatus of claim 1, wherein the circular coil (322) has a continuous circular cross-section.

Claim 15 is directed to an inductively coupled plasma (ICP) generating apparatus as illustrated in Figures 6 and 11 and discussed on page 6, lines 14-33, page 9, line 33 to page 12, line 10 and page 14, line 21 to page 15, line 22, for example, and recites the inductively coupled plasma generating apparatus of claim 1, further comprising a plurality of permanent magnets (440 in Figure 14) arranged around the outer wall of the reaction chamber (110). See page 19, line 27 to page 21, line 8.

Claim 16 is directed to an inductively coupled plasma (ICP) generating apparatus as illustrated in Figures 6 and 11 and discussed on page 6, lines 14-33, page 9, line 33 to page 12, line 10 and page 14, line 21 to page 15, line 22, for example, and recites the inductively coupled plasma generating apparatus of claim 15, wherein the plurality of permanent magnets (440 in Figure 14) are arranged around the outer wall of the reaction chamber (110) such that their N and S poles alternate. See page 19, line 27 to page 21, line 8.

Claim 17 is directed to an inductively coupled plasma (ICP) generating apparatus as illustrated in Figures 6 and 11 and discussed on page 6, lines 14-33, page 9, line 33 to page 12, line 10 and page 14, line 21 to page 15, line 22, for example, and recites the inductively coupled plasma generating apparatus of claim 15, wherein the plurality of permanent magnets (440 in Figure 14) are arranged at a region where the magnitude of a magnetic field generated by the antenna (120/320) is relatively weak. See page 19, line 27 to page 21, line 8.

Claim 18 is directed to an inductively coupled plasma (ICP) generating apparatus as illustrated in Figure 14 and discussed on page 19, line 27 to page 21, line 8, for example, and recites the inductively coupled plasma generating apparatus of claim 15, wherein the plurality of permanent magnets (440) are arranged such that they can revolve simultaneously about a central axis of the reaction chamber (110) to shift their positions according to the distribution of the magnetic field generated by the antenna (420).

Claim 19 is directed to an inductively coupled plasma (ICP) generating apparatus as illustrated in Figure 15 and discussed on page 21, line 9 to page 21, line 34, for example, and recites the inductively coupled plasma generating apparatus of claim 1, further comprising: a matching network (530) connected between the radio frequency power source (532) and the antenna (520); and a capacitor (534) connected between the matching network and the antenna (520), in parallel with the antenna (520).

Claim 20 is directed to an inductively coupled plasma (ICP) generating apparatus as illustrated in Figure 15 and discussed on page 21, line 9 to page 21, line 34, for example, and recites the inductively coupled plasma generating apparatus of claim 19, wherein the plurality of coils of the antenna (520) are connected in series to the radio frequency power source (532).

Claim 19 is directed to an inductively coupled plasma (ICP) generating apparatus as illustrated in Figure 16 and discussed on page 21, line 9 to page 21, line 34, for example, and recites the inductively coupled plasma generating apparatus of claim 19, wherein at least one of the coils of the antenna (520) is connected in parallel to the radio frequency power source (532).

Claim 25 is directed to an inductively coupled plasma (ICP) generating apparatus as illustrated in Figures 6 and 11 and discussed on page 6, lines 14-33, page 9, line 33 to page 12, line 10 and page 14, line 21 to page 15, line 22, for example, and recites the inductively coupled plasma generating apparatus of claim 1, wherein the first (324) and third (326) serpentine coils and the circular coil (322) are three separate coils, and further comprising a first connection coil (that communicatively connects the first serpentine coil (324) to the circular coil (322) and

a second connection coil that communicatively connects the first serpentine coil (324) to the third serpentine coil.

Claim 26 is directed to an inductively coupled plasma (ICP) generating apparatus as illustrated in Figures 6 and 11 and discussed on page 6, lines 14-33, page 9, line 33 to page 12, line 10 and page 14, line 21 to page 15, line 22, for example, and recites the inductively coupled plasma generating apparatus of claim 1, wherein the inner and outer loops of the third serpentine coil, the inner and outer loops of the first serpentine coil (324) and the circular coil (322) are concentric.

Claim 27 is directed to an inductively coupled plasma (ICP) generating apparatus as illustrated in Figures 6 and 11 and discussed on page 6, lines 14-33, page 9, line 33 to page 12, line 10 and page 14, line 21 to page 15, line 22, for example, and recites the inductively coupled plasma generating apparatus of claim 1, wherein the first continuous serpentine coil is connected to the RF power source (132) at the end away from the second circular coil (322), and wherein the second circular coil (322) is connected to ground at the end away from the first continuous serpentine coil.

B. Claim 28 and Claims Dependent from Claim 28

Claim 28 is directed to an inductively coupled plasma (ICP) generating apparatus as illustrated in Figures 6 and 11 and discussed on page 6, lines 14-33, page 9, line 33 to page 12, line 10 and page 14, line 21 to page 15, line 22, for example, and recites:

An inductively coupled plasma (ICP) generating apparatus comprising:

an evacuated reaction chamber (110);

an antenna (120/320) installed at an upper portion of the reaction chamber (110) to induce an electric field for ionizing reaction gas supplied into the reaction chamber (110) and generating plasma; and

a radio frequency (RF) power source (132) connected to the antenna (120/320) to apply radio frequency power to the antenna (120/320),

wherein the antenna (120/320) comprises a coil comprising an open ended serpentine continuous first portion (324), a separate open ended circular continuous second portion (322) connected end to end from one end of the single serpentine

first portion (324) to one end of the single circular second portion (322), and an open ended serpentine continuous third portion (326) surrounding, but not overlapping the serpentine continuous first portion (324).

Claim 29 is directed to an inductively coupled plasma (ICP) generating apparatus as illustrated in Figures 6 and 11 and discussed on page 6, lines 14-33, page 9, line 33 to page 12, line 10 and page 14, line 21 to page 15, line 22, for example, and recites the inductively coupled plasma generating apparatus of claim 28, wherein the circular continuous second portion (322) is arranged at a center portion of the antenna (120/320), the serpentine continuous first portion (324) is arranged around and connected to the circular continuous second portion (322), and the serpentine continuous third portion (326) is arranged around and connected to the serpentine continuous first portion (324).

Claim 30 is directed to an inductively coupled plasma (ICP) generating apparatus as illustrated in Figures 6 and 11 and discussed on page 6, lines 14-33, page 9, line 33 to page 12, line 10 and page 14, line 21 to page 15, line 22, for example, and recites the inductively coupled plasma generating apparatus of claim 28, wherein the serpentine continuous first portion (324) is connected to the RF power source (132) at an end region away from the circular continuous second portion (322), and wherein the circular continuous second portion (322) is connected to ground at an end region away from the serpentine continuous first portion (324).

Claim 31 is directed to an inductively coupled plasma (ICP) generating apparatus as illustrated in Figures 6 and 11 and discussed on page 6, lines 14-33, page 9, line 33 to page 12, line 10 and page 14, line 21 to page 15, line 22, for example, and recites the inductively coupled plasma generating apparatus of claim 28, wherein the serpentine continuous first portion (324), the serpentine continuous second portion (326), and the circular continuous second portion (322) are separate coils, and further comprising a connection coil (328a and 328b) that communicatively connects the serpentine continuous first portion (324) to the circular continuous second portion (322) and the serpentine continuous first portion (324) to the serpentine continuous second portion (326).

C. Claim 32

Claim 32 is directed to an inductively coupled plasma (ICP) generating apparatus as illustrated in Figures 6 and 11 and discussed on page 6, lines 14-33, page 9, line 33 to page 12, line 10 and page 14, line 21 to page 15, line 22, for example, and recites:

An inductively coupled plasma (ICP) generating apparatus comprising:

an evacuated reaction chamber (110);

an antenna (120/320) installed at an upper portion of the reaction chamber (110) to induce an electric field for ionizing reaction gas supplied into the reaction chamber (110) and generating plasma; and

a radio frequency (RF) power source (132) connected to the antenna (120/320) to apply radio frequency power to the antenna (120/320),

wherein the antenna (120/320) comprises three coils:

a first center, circular coil (322);

a second serpentine shaped coil (324) surrounding the first coil (322); and

a third coil (326) communicatively connecting the first coil (322) to the second coil (324);

wherein the second serpentine shaped coil (324) has inner portions shaped to nest in a complementary manner to the shape of the outer surface of the first coil (322), wherein the second serpentine shaped coil (324) has outer portions shaped to nest in a complementary manner to the shape of the inner surface of the third coil (326), and wherein the second serpentine shaped coil (324) has connecting portions connecting the inner portions and the outer portions and the connecting portions are aligned in approximately radial directions, wherein the third coil (326) has inner portions complementary to the outer surface of the second coil (324), outer portions complementary to the inner surface of the reaction chamber (110) and connecting portions connecting the inner portions and the outer portions, and wherein the first (322), second (324) and third (326) coil do not overlap one another.

VI. Grounds of Rejection to be Reviewed on Appeal

A. Whether the Final Office Action has established *prima facie* of obviousness for claims 1, 9-11, 13-14, and 27 under 35 USC § 103(a) over *Lee et al.* (U.S. Patent No. 6,288,493 or JP 2001-085196, hereinafter "*Lee*") in view of *Wang et al.* (U.S. Patent Publication No. 2003/0111181, hereinafter "*Wang*").

B. Whether the Final Office Action has established *prima facie* of obviousness for claims 2, 3, 12, 25, 26 and 28-32 under 35 USC § 103(a) over *Lee* in view of *Wang* and in further view of *Howald et al.* (U.S. Patent No. 6,842,147, hereinafter "*Howald*").

C. Whether the Final Office Action has established *prima facie* of obviousness for claims 15-18 under 35 USC § 103(a) over *Lee* in view of *Wang* and further in view of *Hemker et al.* (U.S. Patent Publication No. 2004/0011467, hereinafter "*Hemker*") or *Bailey et al.* (U.S. Patent Publication No. 2003/0010454, hereinafter "*Bailey*").

D. Whether the Final Office Action has established *prima facie* of obviousness for claims 19-21 under 35 USC § 103(a) over *Lee* in view of *Wang* and further in view of *Kwon et al.* (U.S. Patent No. 6,653,988, hereinafter "*Kwon*") or *Chen et al.* (U.S. Patent No. 6,164,241, hereinafter "*Chen*").

E. Whether the Final Office Action has established *prima facie* of obviousness for claims 1, 9-11, 13-14, and 27 under 35 USC § 103(a) over *Matsuda et al.* (U.S. Patent Publication No. 2003/0111181, hereinafter "*Matsuda*") in view of *Wang*.

F. Whether the Final Office Action has established *prima facie* of obviousness for claims 2-3, 12, 25-26, and 28-32 under 35 USC § 103(a) over *Matsuda* in view of *Wang* and further in view of *Howald*.

G. Whether the Final Office Action has established *prima facie* of obviousness for claims 15-18 under 35 USC § 103(a) over *Matsuda* in view of *Wang* and further in view of *Hemker* or *Bailey*.

H. Whether the Final Office Action has established *prima facie* of obviousness for claims 19-21 under 35 USC § 103(a) over *Matsuda* in view of *Wang* and further in view of *Kwon* or *Chen*.

I. Whether the Final Office Action has established *prima facie* of obviousness for claims 1, 9-11, 13-14, 27-28, and 30-31 under 35 USC § 103(a) over *Howald* in view of *Wang*.

J. Whether the Final Office Action has established *prima facie* of obviousness for claims 2-3, 12, 25-26, 29, and 32 under 35 USC § 103(a) over *Howald* in view of *Wang* and further in view of *Lee* or *Matsuda*.

K. Whether the Final Office Action has established *prima facie* of obviousness for claims 15-18 under 35 USC § 103(a) over *Howald* in view of *Wang* and further in view of *Hemker* or *Bailey*.

L. Whether the Final Office Action has established *prima facie* of obviousness for claims 19-21 under 35 USC § 103(a) over *Howald* in view of *Wang* and further in view of *Kwon* or *Chen*.

VII. Argument

In the Advisory Action dated September 12, 2007, the Examiner states that "Applicants' reply has overcome the following rejection(s): the USC 103 rejections only with respect to the Okumura et al., US 6,177,646, reference." See page 2 of the Advisory Action. Thus, the arguments below do not address *Okumura et al.*

A. Claims 1, 9-11, 13-14, and 27 as Rejected over *Lee* in view of *Wang*

The Final Office Action dated June 28, 2007 rejected claims 1, 9-11, 13-14 and 27 under 35 U.S.C. §103(a) over *Lee* in view of *Wang*. Appellants submit that the Final Office Action has failed to establish a *prima facie* case of obviousness, thus this rejection has been traversed and Appellants request reversal of the rejection.

The Office Action states that:

> Lee et al. does not expressly disclose wherein the first and third serpentine coils are bent in a zigzag pattern, wherein the first and third serpentine coils comprise an outer loop, an inner loop, and connecting portions between the outer loop and the inner loop, wherein the outer loop of the first serpentine coil and the outer loop of the third serpentine coil are approximately parallel, the inner loop of the first serpentine coil and the inner loop of the third serpentine coils are approximately parallel, the connecting portions of the first serpentine coil are approximately parallel to the connecting portions of the third serpentine coil and are longer than the connecting portions of the third serpentine coil. Wang et al. disclose an inductive coupled plasma apparatus in which a serpentine coil is bent is a zigzag pattern (see, for example, figs. 1-2, 5-10, and their descriptions). Additionally, Okumura et al. disclose an inductive coupled plasma apparatus in which a serpentine coil is bent is a zigzag pattern (see, for example, figs. 3, 14-16 and 21, and their descriptions). Therefore, in view of these disclosures, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the apparatus of Lee et al. as to comprise the claimed coil zigzag shape structure because such coil configuration is used and known to be suitable for generating uniform plasma in an inductive plasma apparatus. Furthermore, the

> configuration of the claimed coils is a matter of choice which a person of ordinary skill in the art would have found obvious absent persuasive evidence that the particular configuration of the claimed coils is significant.

See pages 3-4 of the Office Action (emphasis added).

Appellants submit that the Final Office Action has failed to establish a *prima facie* case of obviousness because: (1) *Wang* and *Lee* are not combinable; and (2) the specification as filed provides evidence that the claimed embodiments of the inductively coupled plasma (ICP) generating apparatuses are more than "a matter of choice."

(1). *Wang* cannot be combined with *Lee*. *Wang* discloses, as previously discussed in the September 26, 2006 Response pages 10-14, which is incorporated herein, "two adjacent loops 260 [that] appear to merge in a single current path." See paragraph [0029] of *Wang* (emphasis added). Furthermore, "portion[s] of the conductors 205*a*, 205*b* lying within the radial path 230*b* are sufficiently close to provide a fairly pure transition between the opposing magnetic fields of the two loops 260*a*, 260*b*." See paragraph [0029] of *Wang* (emphasis added).

Appellants respectfully submit that because *Lee* discloses a single circular antenna loop 300a and a single circular antenna loop 300b in parallel to one another and do not overlap or merge "for generating a uniform distribution of plasma." See *Lee*, Figure 3A. On the other hand, *Wang* discloses "two adjacent loops" (see Figure 2, for example), wherein Wang's loops 260 "merge in a single current path" "to provide a fairly pure transition between the opposing magnetic fields." Thus, the combination of *Lee* and *Wang* would result in either destroying the uniformity of *Lee* or destroying the "fairly pure transition between the opposing magnetic fields of the two loops" of *Wang*. For example, if one of the loops of *Wang* was placed in the antenna device of *Lee*, the "resonant state" between the first and second antennas of *Lee* would probably be destroyed (see Abstract of *Lee*) by the presence of a non-circular antenna loop because *Lee* requires circular loops in an antenna device "for generating a uniform distribution of plasma." On the other hand, *Wang's* "fairly pure transition between the opposing magnetic fields of the two loops" would be destroyed if one of the loops was replaced with the circular loop of *Lee* because

there would not appear to be a "fairly pure transition" (see paragraph [0029] of *Wang*).

Therefore if one or more loops from *Lee* were combined with one or more loops from *Wang*, the advantages of both *Lee* and *Wang* would be destroyed.

(2). The specification as filed provides evidence that the claimed embodiments of the inductively coupled plasma (ICP) generating apparatuses are more than "a matter of choice." Appellants respectfully submit that "the configuration of the claimed coils" is not merely a "matter of choice" as the particular configuration of the claims is significant as discussed throughout the present application, wherein evidence is provided in Figures 12A-12G of the present application.

Specifically, Appellants respectfully submit that the application as filed provides evidence of the significance of the configuration of the coils compared to *Lee*. As described in the original disclosure, Figures 4A and 4B "show the distribution of radial direction components of magnetic fields produced by a conventional secular coil antenna." See the present application, which for convenience will be cited from the published application, paragraph [0012] of U.S. Patent Publication No. 2004/0079485. Comparing Figures 4A and 4B with *Lee's* circular antennas illustrated in Figures 2A, 3A, 3B and 5 illustrates that the discussion of the "prior art" in the present application is similar to the antenna of *Lee*. The applications goes on to compare Figures 4A and 4B (similar to *Lee*) with embodiments of the claimed invention discussing and illustrating differences in calculated inductance between the prior art antennae and embodiments of the claimed antennae. See Figures 12A-12G of the present application and paragraphs [0079]-[0090].

(3). Concerning claims 13 and 14, the Final Office Action states that claims 13 and 14 are obvious as "a matter of choice." See page 4 of the Final Office Action. Appellants submit that as discussed on page 6, lines 14-33, page 9, line 33 to page 12, line 10 and page 14, line 21 to page 15, line 22, for example, the first serpentine coil (324)'s zigzag pattern has a rectangular cross-section having a width smaller than height, as recited in claim 13, and wherein the circular coil (322) has a continuous circular cross-section, as recited in claim 14, is more than "a matter of choice." As definitively stated in the specification as filed:

> As is apparent from FIG. 8, the inductance of the antenna is lowered when the cross-sectional area of the coils is increased with greater width or height of the cross section. In addition, for a given cross-sectional area, the inductance is smaller for coils with narrower widths and greater heights than for coils with greater widths and smaller heights.

See page 12, lines 20-24.

Thus, the Application as filed provides evidence in the form of written description and illustration in Figure 8, for example, that the conformation of the antenna is more than "a matter of choice."

(4). For at least the reasons set forth above, Appellants respectfully submit that the Final Office Action has failed to establish a *prima facie* case of obviousness for at least claim 1. Claims 9-11, 13-14, and 27 depend from claim 1 and a *prima facie* case of obviousness has not been established against these claims for at least the same reasons as discussed concerning claim 1, as well as the other reasons discussed herein. Reversal of the rejection and allowance of the claims is respectfully requested.

B. Claims 2, 3, 12, 25, 26, and 28-32 as Rejected over *Lee* and *Wang* in further view of *Howald*

The Final Office Action rejected claims 2, 3, 12, 25, 26, and 28-32 under 35 U.S.C. §103(a) over *Lee* in view of *Wang* in further view of *Howald*. Appellants submit that the Final Office Action has failed to establish a *prima facie* case of obviousness, thus this rejection has been traversed and Appellants request reversal of the rejection.

The Final Office Action states that "Lee et al., Wang et al., or Okumura et al. do not disclose the first serpentine coil is connected to the circular coil. Howald et al. discloses an inductively [coupled] plasma apparatus in which [an] antenna [comprises] first coil 232, second coil 228, and third coil 234 and wherein first coil 232 is connected to second coil 228 (see, for example, Figs. 1 and 3, and their descriptions)." See page 5 of the Final Office Action.

Appellants submit that *Howald* fails to cure the deficiencies of *Lee* and *Wang*. Specifically, *Howald* does not disclose or suggest as recited in claim 1, at least the feature of the antenna comprising at least the feature of a plurality of coils

comprising an open ended first continuous serpentine coil, an open ended second continuous circular coil and an open ended third continuous serpentine coil surrounding the first continuous serpentine coil.

Rather, *Howald* discloses circular loops, as illustrated in Figures 3 and 4, and fails to disclose or suggest the combination of features of claim 1.

Similarly, claim 28 recites, as mentioned above, at least the feature of an antenna comprising a coil comprising an open ended serpentine continuous first portion, a separate open ended circular continuous second portion connected end to end from one end of the first serpentine first portion to one end of the single circular second portion, and an open ended serpentine continuous third portion surrounding, but not overlapping the serpentine continuous first portion. Appellants submit that for at least the reasons set forth above concerning claim 1 with *Lee* and *Wang*, as well as *Howald*, that claim 28 is also allowable.

Similarly, claim 32 recites at least the feature of an antenna comprising three coils: a first center, circular coil, a second serpentine shaped coil surrounding the first coil, and a third coil communicatively connecting the first coil to the second coil. Appellants submit that for at least the reasons set forth above concerning claims 1 and 28, that the combination of *Lee*, *Wang* and *Howald* fail to make a *prima facie* case of obviousness against claims 1, 28, and 32.

Concerning claim 25, which recites, the inductively coupled plasma generating apparatus of claim 1, wherein the first and third serpentine coils and the circular coil are three separate coils, and further comprising a first connection coil that communicatively connects the first serpentine coil to the circular coil and a second connection coil that communicatively connects the first serpentine coil to the third serpentine coil, Appellants submit that *Lee*, *Wang* and *Howald* fail to make a *prima facie* case of obviousness against claim 25 as, even if combined, would not have the three separate coils including the connection coils as described in claim 25. Rather, *Lee* discloses three circular loops, *Wang* discloses crossing loops and *Howald* discloses circular loops, thus the combination, assuming *arguendo* that one of ordinary skill in the art would combine the three references, still fails to make a *prima facie* case of obviousness against claim 25.

For at least the reasons set forth above, Appellants respectfully submit that the Final Office Action has failed to establish a *prima facie* case of obviousness for at least claims 1 and 28. Claims 2, 3, 12, 25 and 26 depend from claim 1, and claims 29-31 depend from claim 28, and a *prima facie* case of obviousness has not been established against these claims for at least the same reasons as discussed concerning claims 1 and 28, as well as the reasons discussed above. Reversal of the rejection and allowance of the claims is respectfully requested.

C. Claims 15-18 as Rejected over *Lee* in view of *Wang* and further in view of *Hemker* or *Bailey*

The Final Office Action rejects claims 15-18 under 35 U.S.C. §103(a) over *Lee* in view of *Wang* and further in view of *Hemker* or *Bailey*. Appellants submit that the Final Office Action has failed to establish a *prima facie* case of obviousness, thus this rejection has been traversed and Appellants request reversal of the rejection.

Appellants submit that claims 15-18 depend from claim 1, and that the discussion above concerning *Lee* and *Wang* applies equally to claims 15-18 which depend from claim 1.

Hemker fails to cure the deficiencies of *Lee* and *Wang*. *Hemker* discloses *Hemker* discloses a plasma processing system which includes an RF antenna arrangement 102 which can have a 3-D, stock configuration, a planar spiral coil, as illustrated in Fig. 3B, a different number of loops, each of which may have a different thickness, as illustrated in Fig. 3C, a different number of loops arranged vertically, as illustrated in Fig. 3D, multiple individually driven antennas as illustrated in Fig. 3E, and/or a domed antenna, which may be a single coil as shown in Fig. 3F or may involve multiple coils driven together or with a plurality of independent supplies. See page 5, paragraph [0058] and Figs. 3B to 3F. However, *Hemker* fails to disclose or suggest the combination of features of claim 1, including at least the features mentioned above that are also missing from *Lee* and *Wang*.

Similarly, *Bailey* fails to cure the deficiencies of *Lee* and *Wang*. Rather, *Bailey* discloses a plasma confinement arrangement which includes an antenna arrangement 304 that is coupled to a first RF power supply 306 via a matching

network 307. However, *Bailey* fails to disclose or suggest at least the features mentioned above missing from *Lee* and *Wang* and claim 1.

For at least the reasons set forth above, Appellants respectfully submit that the Final Office Action has failed to establish a *prima facie* case of obviousness for at least claim 1. Claims 15-18 depend from claim 1 and a *prima facie* case of obviousness has not been established against these claims for at least the same reasons as discussed concerning claim 1. Reversal of the rejection and allowance of the claims is respectfully requested.

D. Claims 19-21 as Rejected over *Lee* in view of *Wang* and further in view of *Kwon* or *Chen*

The Final Office Action rejects claims 19-21 under 35 U.S.C. §103(a) over *Lee* in view of *Wang* and further in view of *Kwon* or *Chen*. Appellants submit that the Final Office Action has failed to establish a *prima facie* case of obviousness, thus this rejection has been traversed and Appellants request reversal of the rejection.

Claims 19-21 depend from claim 1, and Appellants submit that the arguments concerning claim 1 apply equally here. Appellants further submit that *Kwon* and/or *Chen* fail to cure the deficiencies of *Lee* and *Wang*.

Kwon fails to cure the deficiencies of *Lee* and *Wang*. *Kwon* discloses a whirl antenna with a metal plate 130 installed over and apart from the whirl antenna. See Figs 2a and 2b and col. 3, lines 29-34. However, *Kwon* fails to disclose or suggest, as recited in claim 1, at least the feature of a plurality of coils comprising an open ended first continuous serpentine coil, an open ended second continuous circular coil, and an open ended third continuous serpentine coil surrounding the first continuous serpentine coil, wherein the first and third serpentine coils are bent in a zigzag pattern, and wherein the first and third serpentine coils comprise an outer loop, an inner loop, and connecting portions between the outer loop and the inner loop, wherein the outer loop of the first serpentine coil and the outer loop of the third serpentine coil are approximately parallel, the inner loop of the first serpentine coil and the inner loop of the third serpentine coils are approximately parallel, the connecting portions of the first serpentine coil are approximately parallel to the connecting portions of the third serpentine coil and are longer than the connecting

portions of the third serpentine coil, and the first serpentine coil does not overlap or cross the any portion of the third serpentine coil. Rather, *Kwon* discloses that several antenna units Z1 to Z8 form a whirl with a metal plate 130 installed over and apart from the whirl antennas. See *Kwon* col. 2, lines 47-56 and col. 3, lines 29-33.

Thus, *Kwon* does not disclose or suggest the missing features from the combination of *Lee* and *Wang* and also does not disclose or suggest combining Lee and Wang let alone *Lee*, *Wang* and *Kwon*.

Chen also fails to cure the deficiencies of *Lee* and *Wang*. *Chen* discloses, as illustrated in Figures 2A and 2B, two planar spiral coils 110a, 110b. See col. 1, lines 48-50. *Chen* also discloses as illustrated in Figure 3, single-turn coils coil 1, coil 2. See col. 3, lines 49-52. Additionally, *Chen* discloses, as illustrated in Figures 4-7, multiple turn coils including a toroidal coil in Figure 7. However, *Chen's* toroidal coil is not serpentine in shape. See Figures 4-7 of *Chen*. Thus, *Chen* fails to cure the deficiencies of *Lee* and *Wang* and also does not disclose or suggest combining *Lee* and *Wang*, let alone *Lee*, *Wang* and *Chen*.

For at least the reasons set forth above, Appellants respectfully submit that the Final Office Action has failed to establish a *prima facie* case of obviousness for at least claim 1. Claims 19-21 depend from claim 1 and a *prima facie* case of obviousness has not been established against these claims for at least the same reasons as discussed concerning claim 1. Reversal of the rejection and allowance of the claims is respectfully requested.

E. Claims 1, 9-11, 13-14, and 27 as Rejected over *Matsuda* in view of *Wang*

The Final Office Action rejected claims 1, 9-11, 13, 14, and 27 under 35 U.S.C. §103(a) over *Matsuda* in view of *Wang*. Appellants submit that the Final Office Action has failed to establish a *prima facie* case of obviousness, thus this rejection has been traversed and Appellants request reversal of the rejection.

Matsuda, similar to *Lee*, discloses "a plurality of coils disposed concentrically." See Abstract of *Matsuda*. As mentioned above, circular coils as discussed above with *Lee* and concerning *Matsuda* here, cannot be combined with *Wang* as such combination would destroy the uniform distribution of *Matsuda* (see above

discussion concerning *Lee* and *Wang*) or would destroy the "fairly pure transition between the opposing magnetic field of the two loops" of *Wang* (see above discussion of *Lee* and *Wang*).

For at least the reasons set forth above, Appellants respectfully submit that the Final Office Action has failed to establish a *prima facie* case of obviousness for at least claim 1. Claims 9-11, 13-14, and 27 depend from claim 1 and a *prima facie* case of obviousness has not been established against these claims for at least the same reasons as discussed concerning claim 1, as well as the above discussion regarding claims 13 and 14. Reversal of the rejection and allowance of the claims is respectfully requested.

F. Claims 2-3, 12, 25-26, and 28-32 as Rejected over *Matsuda* in view of *Wang* and further in view of *Howald*

The Final Office Action rejected claims 2, 3, 12, 25-26 and 28-32 under 35 U.S.C. §103(a) over *Matsuda* in view of *Wang* and in further view of *Howald*. Appellants submit that the Final Office Action has failed to establish a *prima facie* case of obviousness, thus this rejection has been traversed and Appellants request reversal of the rejection.

Howald fails to cure the deficiencies of *Matsuda* in view of *Wang* for at least the reasons set forth above concerning *Matsuda*, *Wang* and *Howald*. Thus, claims and 32 are allowable for the reasons set forth above concerning claims 1, 28 and 32 with respect to *Matsuda*, *Wang* and *Howald*.

Additionally, as illustrated in Figure 3 of *Howald* and discussed further above, *Howald* discloses circular antenna elements. See *Howald* col. 6, lines 48-65. *Howald* also discloses that single or multiple spiral antenna elements, wound as flat spirals or wound to lie on the surface of a hemisphere can be used. See col. 7, lines 1-4 of *Howald*. As mentioned above, *Wang* cannot be combined with circular antenna such as those disclosed in *Matsuda*, and now *Howald*. Thus, Appellants respectfully submit that *Howald* in view of Wang destroys the functionality of either *Howald* or *Wang* and thus these references cannot be combined.

For at least the reasons set forth above, Appellants respectfully submit that the Final Office Action has failed to establish a *prima facie* case of obviousness for at

least claims 1, 28 and 32. Claims 2-3, 12 and 25-26 depend from claim 1 and claims 29-31 depend from claim 28 and a *prima facie* case of obviousness has not been established against these claims for at least the same reasons as discussed concerning claims 1, 25 and 28. Reversal of the rejection and allowance of the claims is respectfully requested.

G. Claims 15-18 as Rejected over *Matsuda* in view of *Wang* and further in view of *Hemker* or *Bailey*

The Final Office Action rejects claims 15-18 under 35 U.S.C. §103(a) over *Matsuda* in view of *Wang* and further in view of *Hemker* or *Bailey*. Appellants submit that the Final Office Action has failed to establish a *prima facie* case of obviousness, thus this rejection has been traversed and Appellants request reversal of the rejection.

Appellants respectfully submit for the reasons discussed above concerning *Matsuda*, *Wang,* and *Hemker* or *Bailey* that the Final Office Action has failed to establish a *prima facie* case of obviousness for at least claim 1. Claims 15-18 depend from claim 1 and a *prima facie* case of obviousness has not been established against these claims for at least the same reasons as discussed concerning claim 1. Reversal of the rejection and allowance of the claims is respectfully requested.

H. Claims 19-21 as Rejected over *Matsuda* in view of *Wang* and further in view of *Kwon* or *Chen*

The Final Office Action rejects claims 19-21 under 35 U.S.C. §103(a) over *Matsuda* in view of *Wang* and further in view of *Kwon* or *Chen*. Appellants submit that the Final Office Action has failed to establish a *prima facie* case of obviousness, thus this rejection has been traversed and Appellants request reversal of the rejection.

Appellants respectfully submit for the reasons discussed above concerning *Matsuda*, *Wang,* and *Kwon* or *Chen* that the Final Office Action has failed to establish a *prima facie* case of obviousness for at least claim 1. Claims 19-21 depend from claim 1 and a *prima facie* case of obviousness has not been

established against these claims for at least the same reasons as discussed concerning claim 1. Reversal of the rejection and allowance of the claims is respectfully requested.

I. Claims 1, 9-11, 13-14, 27-28, and 30-31 as Rejected over *Howald* in view of *Wang*

The Final Office Action rejects claims 1, 9-11, 13-14, 27-28, and 30-31 under 35 U.S.C. §103(a) over *Howald* in view of *Wang*. Appellants submit that the Final Office Action has failed to establish a *prima facie* case of obviousness, thus this rejection has been traversed and Appellants request reversal of the rejection.

Appellants respectfully submit for the reasons discussed above concerning *Howald* and *Wang*, that the Final Office Action has failed to establish a *prima facie* case of obviousness against claims 1, 9-11, 13, 14, 27, 28, 30, and 31 for at least the same reasons as discussed concerning claims 1, 13, 14 and 28. Reversal of the rejection and allowance of the claims is respectfully requested.

J. Claims 2-3, 12, 25-26, 29, and 32 as Rejected over *Howald* in view of *Wang* and further in view of *Lee* or *Matsuda*

The Final Office Action rejects claims 2-3, 12, 25-26, 29, and 32 under 35 U.S.C. §103(a) over *Howald* in view of *Wang* and further in view of *Lee* or *Matsuda*. Appellants submit that the Final Office Action has failed to establish a *prima facie* case of obviousness, thus this rejection has been traversed and Appellants request reversal of the rejection.

Appellants respectfully submit for the reasons discussed above concerning *Howald*, *Wang*, *Lee*, and *Matsuda* that the Final Office Action has failed to establish a *prima facie* case of obviousness for at least claims 1, 28 and 32. Claims 2-3, 12, and 25-26 depend from claim 1 and claim 29 depends from claim 28 and a *prima facie* case of obviousness has not been established against these claims for at least the same reasons as discussed concerning claims 1 and 28. Reversal of the rejection and allowance of the claims is respectfully requested.

K. Claims 15-18 as Rejected over *Howald* in view of *Wang* and further in view of *Hemker* or *Bailey*

The Final Office Action rejects claims 15-18 under 35 U.S.C. §103(a) over *Howald* in view of *Wang* and further in view of *Hemker* or *Bailey*. Appellants submit that the Final Office Action has failed to establish a *prima facie* case of obviousness, thus this rejection has been traversed and Appellants request reversal of the rejection.

Appellants respectfully submit for the reasons discussed above concerning *Howald*, *Wang*, *Hemker*, and *Bailey* that the Final Office Action has failed to establish a *prima facie* case of obviousness for at least claim 1. Claims 15-18 depend from claim 1 and a *prima facie* case of obviousness has not been established against these claims for at least the same reasons as discussed concerning claim 1. Reversal of the rejection and allowance of the claims is respectfully requested.

L. Claims 19-21 as Rejected over *Howald* in view of *Wang* and further in view of *Kwon* or *Chen*

The Final Office Action rejects claims 19-21 under 35 U.S.C. §103(a) over *Howald* in view of *Wang* and further in view of *Kwon* or *Chen*. Appellants submit that the Final Office Action has failed to establish a *prima facie* case of obviousness, thus this rejection has been traversed and Appellants request reversal of the rejection.

Appellants respectfully submit for the reasons discussed above concerning *Howald*, *Wang*, *Kwon*, and *Chen* that the Final Office Action has failed to establish a *prima facie* case of obviousness for at least claim 1. Claims 19-21 depend from claim 1 and a *prima facie* case of obviousness has not been established against these claims for at least the same reasons as discussed concerning claim 1. Reversal of the rejection and allowance of the claims is respectfully requested.

VIII. Claims Appendix

See attached Claims Appendix for a copy of the claims involved in the appeal.

IX. Evidence Appendix

See attached Evidence Appendix for copies of evidence relied upon by Appellant.

X. Related Proceedings Appendix

See attached Related Proceedings Appendix for copies of decisions identified in Section II, supra.

Respectfully submitted,

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VIII. CLAIMS APPENDIX

The Appealed Claims

1. An inductively coupled plasma (ICP) generating apparatus comprising:

an evacuated reaction chamber;

an antenna installed at an upper portion of the reaction chamber to induce an electric field for ionizing reaction gas supplied into the reaction chamber and generating plasma; and

a radio frequency (RF) power source connected to the antenna to apply radio frequency power to the antenna,

wherein the antenna comprises a plurality of coils comprising an open ended first continuous serpentine coil, an open ended second continuous circular coil, and an open ended third continuous serpentine coil surrounding the first continuous serpentine coil, wherein the first and third serpentine coils are bent in a zigzag pattern, and wherein the first and third serpentine coils comprise an outer loop, an inner loop, and connecting portions between the outer loop and the inner loop, wherein the outer loop of the first serpentine coil and the outer loop of the third serpentine coil are approximately parallel, the inner loop of the first serpentine coil and the inner loop of the third serpentine coils are approximately parallel, the connecting portions of the first serpentine coil are approximately parallel to the connecting portions of the third serpentine coil and are longer than the connecting portions of the third serpentine coil, and the first serpentine coil does not overlap or cross the any portion of the third serpentine coil.

2. The inductively coupled plasma generating apparatus of claim 1, wherein the circular coil is arranged at a center portion of the antenna and the first serpentine coil is arranged around and connected to the circular coil, and wherein the third serpentine coil is shaped to nest around and outline the first serpentine coil.

3. The inductively coupled plasma generating apparatus of claim 2, wherein the circular coil has a relatively small radius to reduce the area of opposing portions between the circular coil and the serpentine coil.

9. The inductively coupled plasma generating apparatus of claim 1, wherein the first and third serpentine coils have a zigzag pattern with equally spaced outer loop and inner loop sections, and wherein the first and third serpentine coils have an equal number of equally spaced outer loop and inner loop sections.

10. The inductively coupled plasma generating apparatus of claim 9, wherein the first and third serpentine coils have a plurality of outer portions extending along the circumference and a plurality of inner portions bent toward the center portion.

11. The inductively coupled plasma generating apparatus of claim 10, wherein the inner and outer loops of the first and third serpentine coils are arranged to correspond to center and edge portions of the reaction chamber, respectively.

12. The inductively coupled plasma generating apparatus of claim 1, wherein the plurality of coils further comprise at least one connection coil, wherein the connection coil connects the first serpentine coil and the circular coil of the plurality of coils.

13. The inductively coupled plasma generating apparatus of claim 1, wherein the first serpentine coil's zigzag pattern has a rectangular cross-section having a width smaller than height.

14. The inductively coupled plasma generating apparatus of claim 1, wherein the circular coil has a continuous circular cross-section.

15. The inductively coupled plasma generating apparatus of claim 1, further comprising a plurality of permanent magnets arranged around the outer wall of the reaction chamber.

16. The inductively coupled plasma generating apparatus of claim 15, wherein the plurality of permanent magnets are arranged around the outer wall of the reaction chamber such that their N and S poles alternate.

17. The inductively coupled plasma generating apparatus of claim 15, wherein the plurality of permanent magnets are arranged at a region where the magnitude of a magnetic field generated by the antenna is relatively weak.

18. The inductively coupled plasma generating apparatus of claim 15, wherein the plurality of permanent magnets are arranged such that they can revolve simultaneously about a central axis of the reaction chamber to shift their positions according to the distribution of the magnetic field generated by the antenna.

19. The inductively coupled plasma generating apparatus of claim 1, further comprising:

a matching network connected between the radio frequency power source and the antenna; and

a capacitor connected between the matching network and the antenna, in parallel with the antenna.

20. The inductively coupled plasma generating apparatus of claim 19, wherein the plurality of coils of the antenna are connected in series to the radio frequency power source.

21. The inductively coupled plasma generating apparatus of claim 19, wherein at least one of the coils of the antenna is connected in parallel to the radio frequency power source.

25. The inductively coupled plasma generating apparatus of claim 1, wherein the first and third serpentine coils and the circular coil are three separate coils, and further comprising a first connection coil that communicatively connects the first serpentine coil to the circular coil and a second connection coil that communicatively connects the first serpentine coil to the third serpentine coil.

26. The inductively coupled plasma generating apparatus of claim 1, wherein the inner and outer loops of the third serpentine coil, the inner and outer loops of the first serpentine coil and the circular coil are concentric.

27. The inductively coupled plasma generating apparatus of claim 1, wherein the first continuous serpentine coil is connected to the RF power source at the end away from the second circular coil, and wherein the second circular coil is connected to ground at the end away from the first continuous serpentine coil.

28. An inductively coupled plasma (ICP) generating apparatus comprising:

an evacuated reaction chamber;

an antenna installed at an upper portion of the reaction chamber to induce an electric field for ionizing reaction gas supplied into the reaction chamber and generating plasma; and

a radio frequency (RF) power source connected to the antenna to apply radio frequency power to the antenna,

wherein the antenna comprises a coil comprising an open ended serpentine continuous first portion, a separate open ended circular continuous second portion connected end to end from one end of the single serpentine first portion to one end of the single circular second portion, and an open ended serpentine continuous third portion surrounding, but not overlapping the serpentine continuous first portion.

29. The inductively coupled plasma generating apparatus of claim 28, wherein the circular continuous second portion is arranged at a center portion of the antenna, the serpentine continuous first portion is arranged around and connected to the circular continuous second portion, and the serpentine continuous third portion is arranged around and connected to the serpentine continuous first portion.

30. The inductively coupled plasma generating apparatus of claim 28, wherein the serpentine continuous first portion is connected to the RF power source at an end region away from the circular continuous second portion, and wherein the circular continuous second portion is connected to ground at an end region away from the serpentine continuous first portion.

31. The inductively coupled plasma generating apparatus of claim 28, wherein the serpentine continuous first portion, the serpentine continuous second portion, and the circular continuous second portion are separate coils, and further comprising a connection coil that communicatively connects the serpentine

continuous first portion to the circular continuous second portion and the serpentine continuous first portion to the serpentine continuous second portion.

32. An inductively coupled plasma (ICP) generating apparatus comprising:

an evacuated reaction chamber;

an antenna installed at an upper portion of the reaction chamber to induce an electric field for ionizing reaction gas supplied into the reaction chamber and generating plasma; and

a radio frequency (RF) power source connected to the antenna to apply radio frequency power to the antenna,

wherein the antenna comprises three coils:

a first center, circular coil;

a second serpentine shaped coil surrounding the first coil; and

a third coil communicatively connecting the first coil to the second coil;

wherein the second serpentine shaped coil has inner portions shaped to nest in a complementary manner to the shape of the outer surface of the first coil, wherein the second serpentine shaped coil has outer portions shaped to nest in a complementary manner to the shape of the inner surface of the third coil, and wherein the second serpentine shaped coil has connecting portions connecting the inner portions and the outer portions and the connecting portions are aligned in approximately radial directions, wherein the third coil has inner portions complementary to the outer surface of the second coil, outer portions complementary to the inner surface of the reaction chamber and connecting portions connecting the inner portions and the outer portions, and wherein the first, second and third coils do not overlap one another.

IX. EVIDENCE APPENDIX

Not applicable.

X. RELATED PROCEEDINGS APPENDIX

Not applicable.